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AUTOMOTIVE DIESEL MAINTENANCE 2. UNIT X, AUTOMATIC TRANSMISSIONS--HYDRAULIC SYSTEMS (PART II).

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THIS MODULE OF A 25-MODULE COURSE IS DESIGNED TO PROVIDE A SUMMARY OF MAINTENANCE PROCEDURES FOR AUTOMATIC TRANSMISSIONS USED ON DIESEL POWERED VEHICLES. TOPICS ARE (1) CHECKING THE HYDRAULIC SYSTEM, (2) SERVICING THE HYDRAULIC SYSTEM, (3) EXAMINING THE RANGE CONTROL VALVE, (4) EXAMINING THE LOCK-UP AND FLOW VALVE, (5) EXAMINING THE MAIN REGULATOR VALVE, (6) EXAMINING THE BRAKE VALVE, AND (7) DUAL PATH TRANSMISSION PRINCIPLE. THE MODULE CONSISTS OF A SELF-INSTRUCTIONAL PROGRAMED TRAINING FILM "SUMMARIZING MECHANICAL AND AUTOMATIC TRANSMISSIONS" AND OTHER MATERIALS. SEE VT 005 685 FOR FURTHER INFORMATION. MODULES IN THIS SERIES ARE AVAILABLE AS VT 005 685 - VT 005 709. MODULES FOR "AUTOMATIVE DIESEL MAINTENANCE 1" ARE AVAILABLE AS VT 005 655 - VT 005 684. THE 2-YEAR PROGRAM OUTLINE FOR "AUTOMOTIVE DIESEL MAINTENANCE 1 AND 2" IS AVAILABLE AS VT 006 006. THE TEXT MATERIAL, TRANSPARENCIES, PROGRAMED TRAINING FILM, AND THE ELECTRONIC TUTOR MAY BE RENTED (FOR $1.75 PER WEEK) OR PURCHASED FROM THE HUMAN ENGINEERING INSTITUTE, HEADQUARTERS AND DEVELOPMENT CENTER, 2341 CARNEGIE AVENUE, CLEVELAND, OHIO 44115. (HC)

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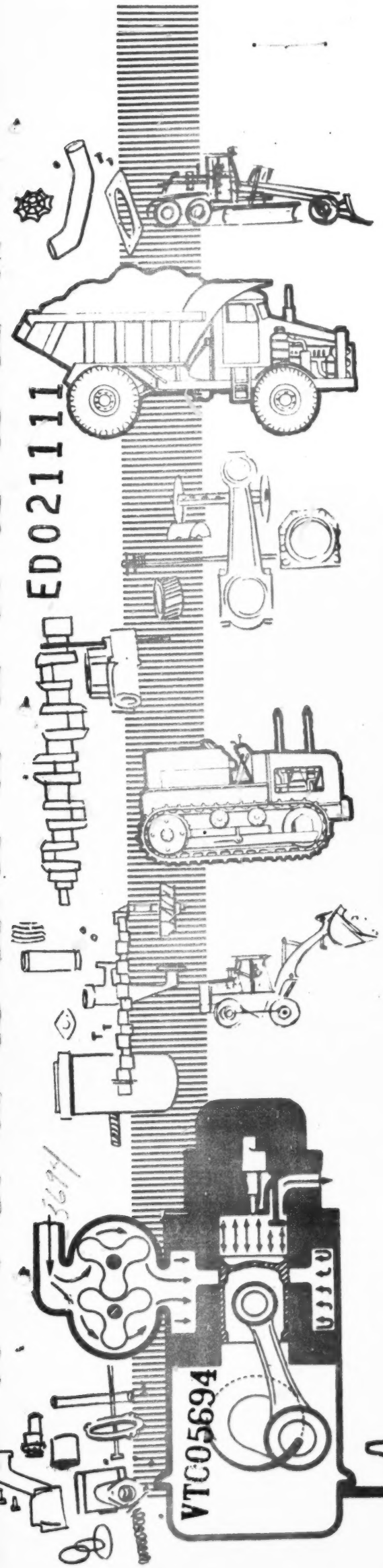

STUDY AND READING MATERIALS

AUTOMOTIVE DIESEL MAINTENANCE 2

AUTOMATIC TRANSMISSIONS -- HYDRAULIC SYSTEMS (PART II) UNIT X

SECTION A	CHECKING THE HYDRAULIC SYSTEM
SECTION B	SERVICING THE HYDRAULIC SYSTEM
SECTION C	EXAMINING THE RANGE CONTROL VALVE
SECTION D	EXAMINING THE LOCK-UP AND FLOW VALVE
SECTION F	EXAMINING THE MAIN REGULATOR VALVE
SECTION F	EXAMINING THE BRAKE VALVE
SECTION G	DUAL PATH TRANSMISSION PRINCIPLE

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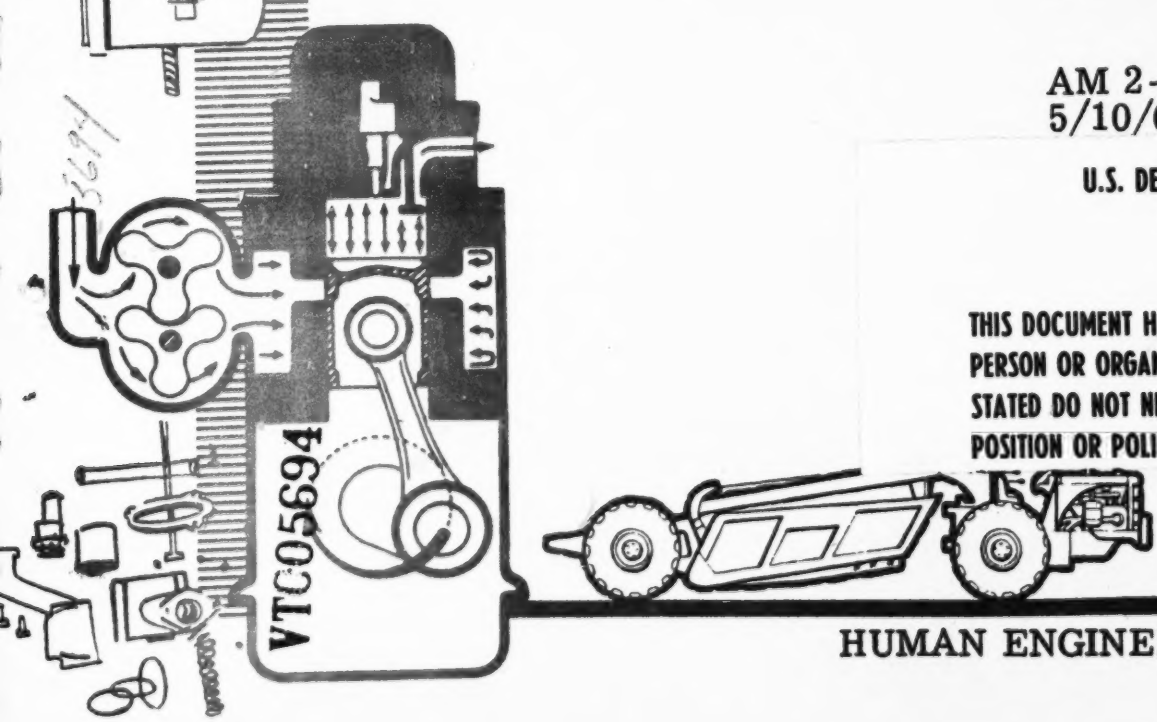

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This unit completes the discussion of the Allison transmission. Coverage includes checking, servicing and inspection of the transmission hydraulic system. Also, there are some teardown and assembly procedures for components of the transmission that periodically require service. In addition, there will be an explanation of the DUAL PATH principle for the DP 8000 Allison transmission.

SECTION A -- CHECKING THE HYDRAULIC SYSTEM

CONVERTER FULL STALL -- Converter full stall can be used to advantage when troubleshooting either the transmission or the engine. To reach full stall, the following procedures should be followed:

1. Check the transmission oil level and add oil if necessary. Bring engine and transmission operating oil to normal operating temperature before conducting the stall test.

2. Securely set the brakes and firmly block the unit being tested.

3. Shift the transmission into sixth range and accelerate the engine to full throttle. Install a remote tachometer and observe for the stall speed. Stall speeds can be checked in third, fourth, or fifth range; but sixth range is recommended for safety reasons.

   CAUTION: Do not allow converter oil temperature to exceed 250 F during stall test.

TRANSMISSION OIL PRESSURE -- The following figures represent oil pressures to use as standards when checking the transmission.

NOTE: These figures are typical. To be certain, check the shop manual for the specific transmission being checked.

Clutch pressures.....100 - 255 psi

Main pressures
(Temperature 200-250 F, 1000 rpm, output stalled)
* First and Reverse.....210 - 235 psi
(Pressure will decrease to 185 psi as vehicle speed increases)
* Neutral, second, third, fourth fifth and sixth.....130 - 155 psi
(Pressure will decrease to 115 psi as vehicle speed increases)

Converter "OUT" pressure..... 30 - 65 psi

Pitot pressure.....0 - 90 psi

Lube pressure.....15 - 35 psi

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* In later model transmissions, 135 - 235 psi is common in all ranges.

Checking Main Oil Pressures -- To check the main oil pressure:

1. Disconnect the clutch pressure gage and install a master pressure gage. The check point is located on the forward face of the main regulator valve. See Figure 1.

2. Warm engine and transmission operating oil to normal operating temperatures.

3. Apply the service brakes and securely block the unit. Run a full throttle stall test in either second, third, fourth, fifth or sixth range. It is recommended for safety reasons to conduct the test in sixth range. The pressure gage should read 130 - 155 psi.

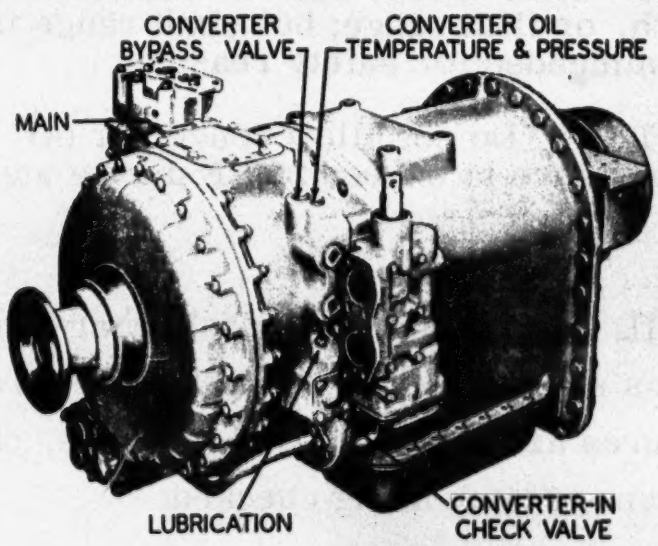

Fig. 1 Oil and temperature check points

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1-Bolt & Lockwasher
2-Valve Cover
3-Gasket
4-Spring Guide
5-Spring
6-Trimmer Plug
7-Spring
8-Spring
9-Trimmer Valve
10-Valve Body
11-Bolt & Lockwasher
12-Bolts & Lockwashers
13-Pressure Check Plug
14-Detent Cap
15-Gasket
16-Spring
17-Detent Ball
18-Trimmer Valve
19-Spring
20-Spring
21-Trimmer Plug
22-Spring
23-Spring Guide
24-Bolt & Lockwasher
25-End Plate
26-Gasket
27-Control Valve
28-Bushing
29-Detent Ball
30-Spring
31-Control Valve Stop
32-Inner Oil Seal
33-Outer Oil Seal
34-Control Valve
Body Gasket

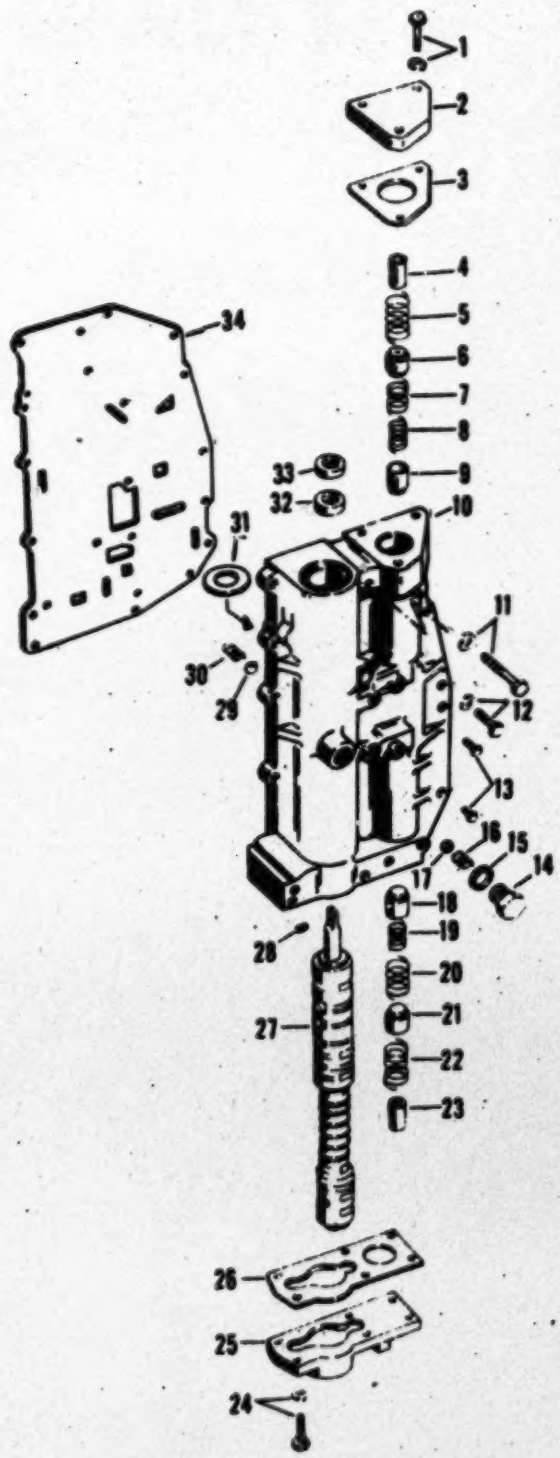


Fig. 2 Exploded view of range control valve

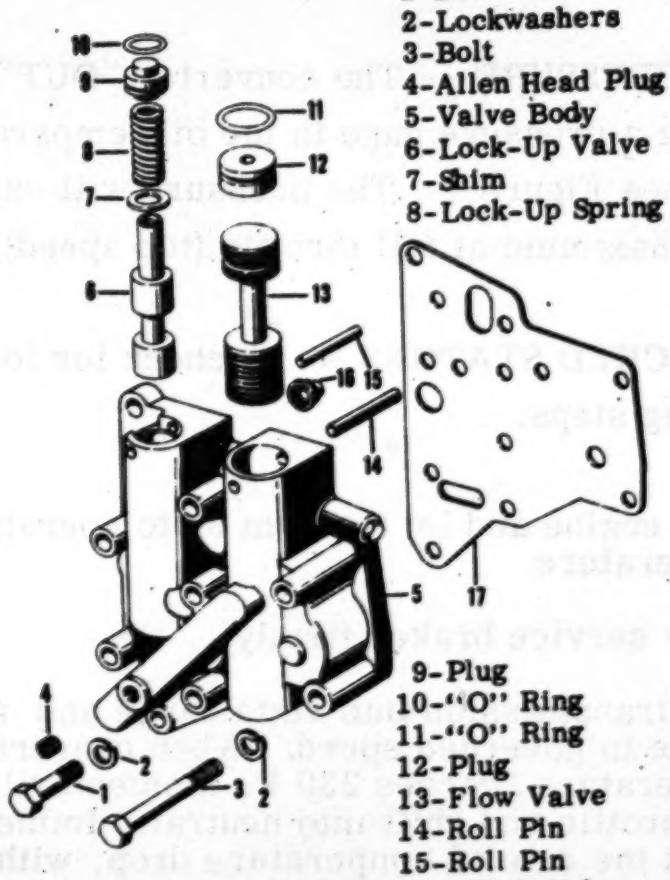


Fig. 3 Exploded view of lock-up and flow valve

CHECKING LUBE OIL PRESSURE -- The lube oil pressure is checked by removing the small square head pipe plug just above the converter "IN" check valve on the converter housing and installing a pressure gage; see Figure 1.

The lube pressure should not be less than 20 psi at stall speed and not more than 35 psi with the engine at governed speed and transmission in neutral.

CHECKING OIL TEMPERATURE -- Maximum converter oil temperature is 250 F. This temperature reading can be taken from the converter oil temperature gage on the instrument panel. However, a master temperature gage can be installed in place of the dash panel gage and a temperature reading taken; see Figure 1.

CONVERTER OUT PRESSURE -- The converter "OUT" pressure is checked by installing a pressure gage in the oil temperature port in the converter housing; see Figure 1. The pressure will vary from 30 psi minimum to 65 psi maximum at full throttle (top speed).

CHECKING FOR LOCKED STATORS -- To check for locked stators, perform the following steps:

1. Start engine and let it warm up to operating temperature.
2. Apply service brakes firmly.
3. Shift transmission into sixth range and accelerate engine to governed speed. When converter oil temperature reaches 230 F, momentarily release the throttle and shift into neutral. Immediately check the rate of temperature drop, with no load on the converter and with maximum input rpm. Temperature should start to drop after 15 seconds. A slow temperature drop rate indicates locking of one or both of the stators. A rapid temperature drop rate indicates normal stator operation.

HYDRAULIC SYSTEM CHECK POINTS --

1. Main oil pressure check point is located on the front side of main pressure regulator valve, which is mounted to the top of the converter housing; see Figure 1. The dash panel clutch pressure gage sending unit is installed at this point. When checking main pressure, it is good practice to disconnect the dash panel gage and install a master gage.
2. Converter temperature check point is located on the left side of the converter housing, just above the cooler inlet and outlet lines; see Figures 1 and 4.

The dash panel temperature gage is installed at this connection. Disconnect the dash panel gage and install a master gage. If desired, the converter "OUT" pressure can be checked at this point. Disconnect the temperature gage and install a pressure gage.

Pitot pressure can be checked by removing the Allen head plug from the cored passage running diagonally cross the valve body; see Figure 3 (4). Install a pressure gage to obtain a pressure reading. Pitot pressure should range between zero and 90 psi, depending on the turbine shaft rpm.

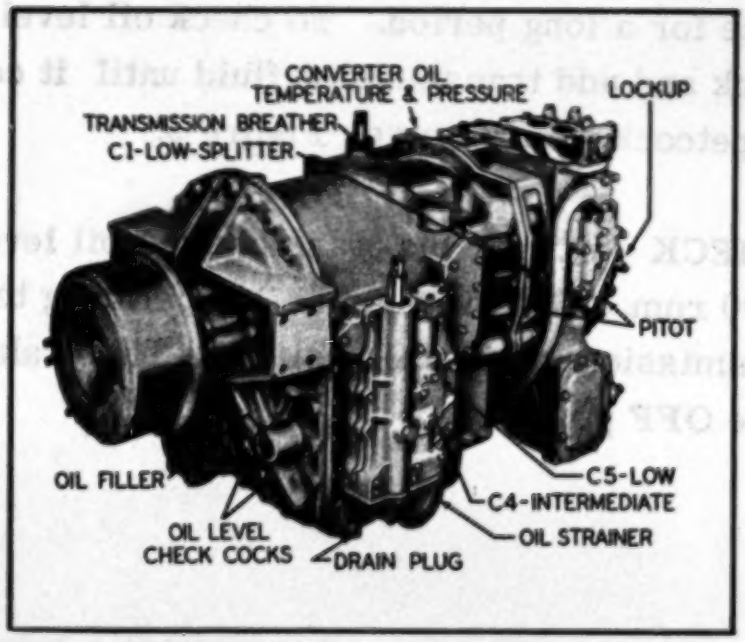


Fig. 4 Oil pressure check points

SECTION B -- SERVICING THE HYDRAULIC SYSTEM

WHEN TO CHANGE OIL -- Transmission oil changes depend largely on operating conditions and company policy. However, if traces of dirt or other foreign material are found in the oil it should be changed immediately. A discoloration or strong odor of the oil indicates the transmission has been overheated; this oil also should be changed. Under normal conditions, change oil at 500 hours. NOTE: Filters should also be changed at this time.

Metal contamination in the oil is serious. The transmission must be drained and the entire system thoroughly cleaned. This usually means that the transmission must be disassembled as metal particles in the oil indicate internal failure. NOTE: Brass or aluminum particles on the screen indicate clutch or converter failure. This situation requires transmission overhaul.

COLD OIL LEVEL CHECK -- The cold check (engine not running) is done only to see if there is sufficient oil in the transmission hydraulic system to start the engine. This oil check is especially important if the vehicle has been standing idle for a long period. To check oil level, open the "FULL" level petcock and add transmission fluid until it comes out the petcock. Close the petcock securely; see Figure 5.

HOT OIL LEVEL CHECK -- Check the transmission oil level with the engine idling at 1,000 rpm. The oil must be at operating temperature (160-210 F) and transmission in neutral position. The brake control valve MUST be in the OFF position.

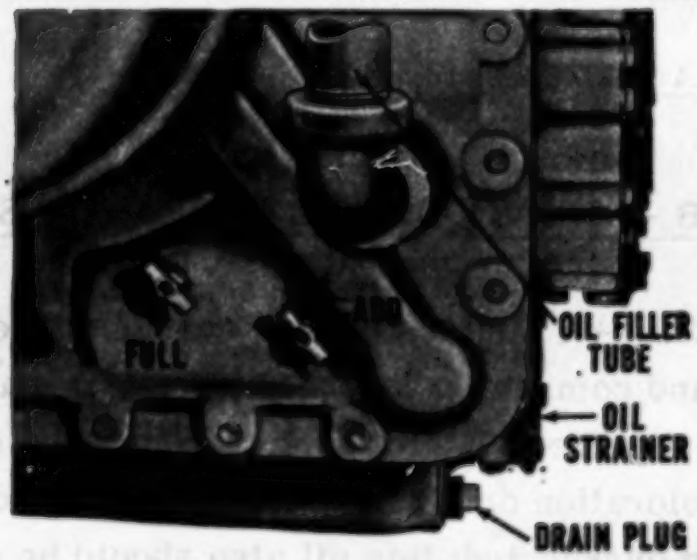


Fig. 5 Oil level check points

To make the hot oil level check, check the level at the rear cover of the straight through models; see Figure 5. Oil level must be maintained between the two oil level petcocks. Approximately 1 1/2 gallons are required to bring the oil level from the lower petcock to the upper petcock.

CHANGING OIL -- The following procedure is to be used when changing oil:

1. Remove the drain plug from the right side of the oil pan; see Figure 5.

2. Remove the strainer assembly from the oil pan. Wash the strainer thoroughly in a suitable solvent. Install a new gasket, then replace the strainer assembly.

3. Clean the magnetic drain plug and install it in the oil pan.

4. Pour 9 1/2 gallons of transmission fluid into the transmission. Start the engine and let it idle for at least two minutes with the transmission in neutral. This will "charge" the system and lower the sump level. With the engine idling at 1000 rpm, add enough oil to bring the level up to the "ADD" petcock. Recheck the oil level after the transmission reaches normal operating temperature.

CHANGING OIL FILTERS -- Oil filters should be changed under the following conditions:

1. Whenever transmission oil is changed.

2. Whenever the transmission or converter is reworked, installed, and run for 500 hours.

REPLACING FILTERS -- The following procedure is to be used when replacing filters: NOTE: Numbers in the following paragraphs refer to Figure 6.

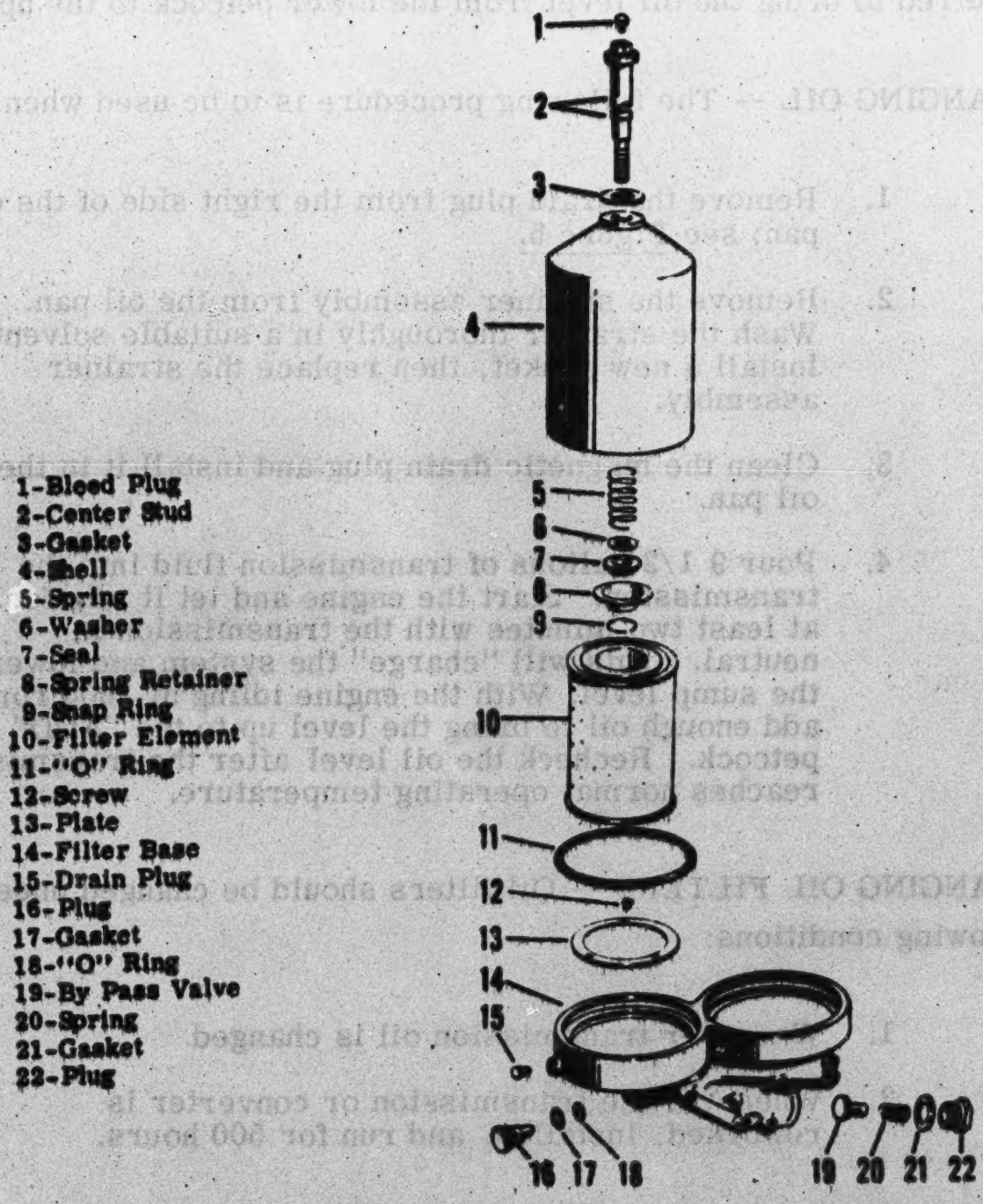


Fig. 6 Exploded view of oil filter

1. Shut engine down. Drain oil from filters into a suitable container by removing plug (15). Loosen center stud (2) until filter body (4) can be removed. Remove old filter element (10) and discard it and the seal ring (11).

2. Wash filter body (4) thoroughly with solvent.

3. Place a new seal ring (11) in the filter base (14). Insert a filter element (10) into the filter body (4) and attach to the filter base with the center stud (2). Be careful not to damage center stud gasket (3) or filter body O-ring (11). Also replace plug (15). Tighten center stud to 30 ft. lbs $\pm$ 5.

4. Repeat the previous stops to service the other filter assembly. After servicing both filters, start engine and check for oil leaks and bleed filters by loosening plugs (1) until oil flows out in a steady stream. Also check transmission oil level and add, if necessary.

FILLER CAP AND BREATHERS -- The transmission oil breather is mounted on the right side of the transmission housing. The breather should be checked periodically and cleaned. Rinse breather in clean fuel oil; remove surplus oil with compressed air. Install breather on transmission housing.

NOTE: If unit is equipped with air filter mounted on filler cap, remove filler cap and cleaner. Check the appropriate service manual for air cleaner servicing.

ADJUSTING SHIFT LINKAGE -- The following procedure is recommended for adjusting shift linkage:

1. Move the valve plunger into the sixth range position. The plunger, in this position, extends farthest out of the valve body.

2. Disconnect the linkage valve plunger. Check to be sure that shift linkage and plunger have remained in the sixth range position.

3. Check the alignment of the hole in the end of the plunger with the corresponding hole in the shift linkage. If the holes do not align, make necessary adjustments in the linkage.

4. The same procedure can be used to check the linkage in any gear range.

SECTION C -- EXAMINING THE RANGE CONTROL VALVE

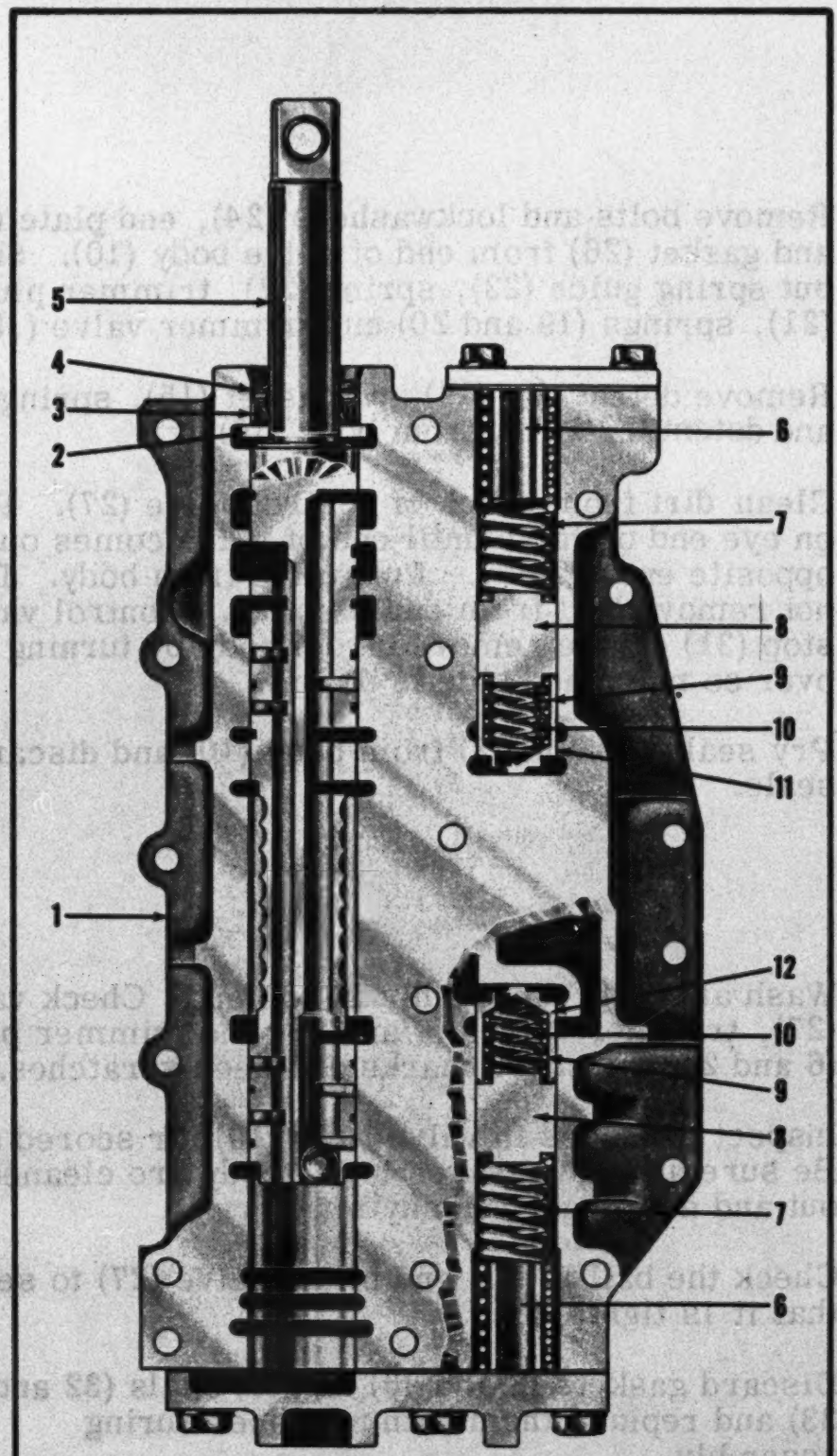
DESCRIPTION -- As mentioned earlier, the range control valve assembly is mounted to the right side of the transmission housing, in a vertical position. This position eliminates binding of the valve when changing ranges, due to the possibility of cab flexing. NOTE: For numbers in the following paragraphs, refer to Figure 7.

The control valve (5) has eight detent pistons, one for each of the gear ranges including neutral. Located in the valve body (1) are the intermediate and neutral trimmer valves consisting of trimmer valves (11 and 12), trimmer valve springs (9 and 10), trimmer plugs (8), trimmer plug springs (7), and spring guides (6).

DISASSEMBLY - - (NOTE: For numbers in the following paragraphs, refer to Figure 2). For the following discussion, it is assumed that the valve has been removed from the transfer plate. When this is done, detent ball (29) and spring (30) will come out of the valve body (10).

Continue with the following steps:

1. Remove bolts and lockwashers (1), valve cover (2), and gasket (3) from valve body (10). Turn valve upside down and shake out spring guide (4), spring (5) trimmer plug (6), springs (7 and 8), and trimmer valve (9).



1-Control Valve Body
2-Valve Stop
3-Inner Oil Seal
4-Outer Oil Seal
5-Control Valve
6-Spring Guides
7-Springs
8-Trimmer Plugs
9-Inner Spring
10-Outer Spring
11-Neutral Trimmer Valve
12-Intermediate Trimmer Valve

Fig. 7 Cutaway view of range control valve

2. Remove bolts and lockwashers (24), end plate (25) and gasket (26) from end of valve body (10). Shake out spring guide (23), spring (22), trimmer plug (21), springs (19 and 20) and trimmer valve (18).

3. Remove detent cap (14) and gasket (15), spring (16) and detent ball (17) from body (10).

4. Clean dirt from shank of control valve (27). Press on eye end of valve until end of valve comes out the opposite end of body. Pull valve from body. Do not remove ball from end of valve. Control valve stop (31) can be removed from body by turning over so machined side is down.

5. Pry seals (32 and 33) from body (10) and discard seals.

INSPECTION:

1. Wash all parts thoroughly in solvent. Check valve (27), trimmer valves (9 and 18) and trimmer plugs (6 and 21) for score marks and deep scratches.

2. Inspect passages in valve body (10) for scored areas. Be sure all oil passages in the body are cleaned out and not plugged in any manner.

3. Check the ball in the end of the valve (27) to see that it is tight.

4. Discard gaskets (3 and 26) and oil seals (32 and 33) and replace them with new ones during assembly.

5. Check spring tensions of trimmer valve springs as follows:

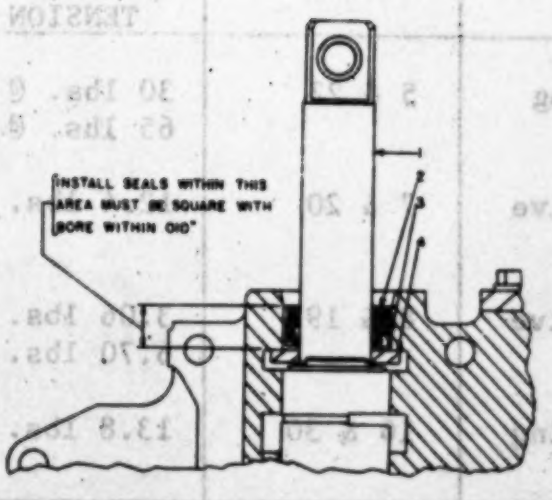
NAME	NO.	SPRING TENSION
Trimmer plug spring	5 & 22	30 lbs. @ 2.79" 65 lbs. @ 1.70"
Trimmer valve spring	7 & 20	12.4 lbs. @ 1.03"
Trimmer valve spring	8 & 19	3.06 lbs. @ 2.22" 6.70 lbs. @ .98"
Detent spring	16 & 30	13.8 lbs. @ .78"

ASSEMBLY -- Install oil seal (32) in body (10) with lip of seal facing in. Place oil seal (33) in body with seal lip facing out. See Figure 8 for proper seal installation.

Lubricate control valve (27) with transmission oil and insert eye of valve (27) into body opposite oil seals. Turn body over so machined surface is up and insert valve stop (31) in slot behind seals (32 and 33). Lubricate lips of seals with transmission oil and push the valve through stop and seals with caution.

Drop detent ball (17) and spring (16) into valve body and install detent cap (14) with a new gasket (15).

Insert springs (19 and 20) into trimmer valve (18). Lubricate valve with transmission oil and insert in bottom of body (10). Install trimmer plug valve (21), spring (22) and guide (23) in body. Secure gasket (26) and end plate (25) to body (10) with bolts and lockwashers (24) and torque bolts to 26-30 ft. lbs.



1-Control Valve
2-Outer Seal
3-Inner Seal
4-Valve Stop

Fig. 8 Proper seal installation

Turn valve so that the plunger end is up. Insert springs (7 and 8) in trimmer valve (9). Lubricate trimmer valve with transmission oil and install valve and springs in body (10). Lubricate trimmer plug (6); insert valve, spring (5) and guide (4) in body. Secure valve cover (2) and new gasket (3) on body (10) with bolts and lockwashers (1) and torque bolts to 13-16 ft. lbs.

Place new valve gasket (34) on oil transfer plate. Place spring (30) and detent ball (29) in position in transfer plate. Lower control valve assembly onto gasket and plate. Be sure detent ball (29) and spring (30) are inserted into correct passage in valve body (10). Secure valve assembly to plate with four bolts and lockwasher (12) and torque bolts 26-32 ft. lbs. To install the valve, refer to the appropriate maintenance manual.

SECTION D -- EXAMINING THE LOCK-UP AND FLOW VALVE

DESCRIPTION - (NOTE: Refer to Figure 3 for the following discussion). The lock-up valve assembly, which is mounted to the right side of the converter housing, contains the lock-up valve (6), spring (8), plug (9) and flow valve (13).

DISASSEMBLY -- Again, it is assumed that the valve has been removed per instruction in the maintenance manual. Proceed with the following steps:

1. Drive the roll pin (15) out of the valve body (5). Remove the plug (12) with O-ring (11) and shake out the flow valve (13).

2. Remove orificed check valve (16) ONLY if it is being replaced.

3. Drive the roll pin (14) out of the valve body (5) and remove the plug (9) with O-ring (10). Lift the lock-up spring (8) and the lock-up valve (6) with shims (7).

   CAUTION: Do not lose the shims (7) as they control the speed at which lock-up occurs. Always replace the same amount of shims that were removed.

INSPECTION -- To do a thorough inspection (after disassembly of the valve) perform the following:

1. Wash all parts in solvent and dry thoroughly. Inspect the valve body (5), lock-up valve (6) and flow valve (13) for deep scratches and score marks. Check to see that the flow valve grooves are sharp. Be sure that all oil passages in the valve body are clear.

2. Check spring tension of lock-up valve spring (8). Tension of a new spring is 22. 2 lbs. at a compressed length of 1. 62", or 25. 7 lbs. at compressed length of 1. 46".

ASSEMBLY -- To assemble the lock-up and flow valve, perform the following steps:

1. Lubricate valve body (5) and valves (6 and 13) with transmission fluid. Insert flow valve (13) into valve body (5). Place a new O-ring (11) on plug (12) and replace the plug. Drive roll pin (15) into body (5). Be sure the pin is . 38" - . 42" below the body mounting face.

2. Slide the original amount of shims (7) over the stem of the lock-up valve (6). Insert the valve and shims into the valve body (5) and install the spring (8). Place a new O-ring (10) on the plug (9) and install the plug. Drive the roll pin (14) into the body (5) so that it is . 03 - . 06" below the valve mounting face.

3. Install a new orificed check valve (16) if it was removed from the valve body (5).

   NOTE: To install the valve, refer to the appropriate maintenance manual.

SECTION E -- EXAMINING THE MAIN REGULATOR VALVE

DESCRIPTION -- (NOTE: For the following discussion, refer to Figure 9). The valve assembly consists of the plug (1), gasket (2), booster signal (3), valve spring (5), stop (6) and main regulator valve (7).

REMOVAL -- For removal of the valve, disconnect the oil lines from valve body (8) and tag them so that they can be reconnected correctly. Also remove the mounting bolts and lockwashers, valve assembly and gasket (11), from the converter housing.

1-Plug
2-Gasket
3-Booster Plug
4-Shim
5-Regulator Valve Spring
6-Stop
7-Regulator Valve
8-Valve Body
9-Set Screw
10-Check Valve
11-Gasket

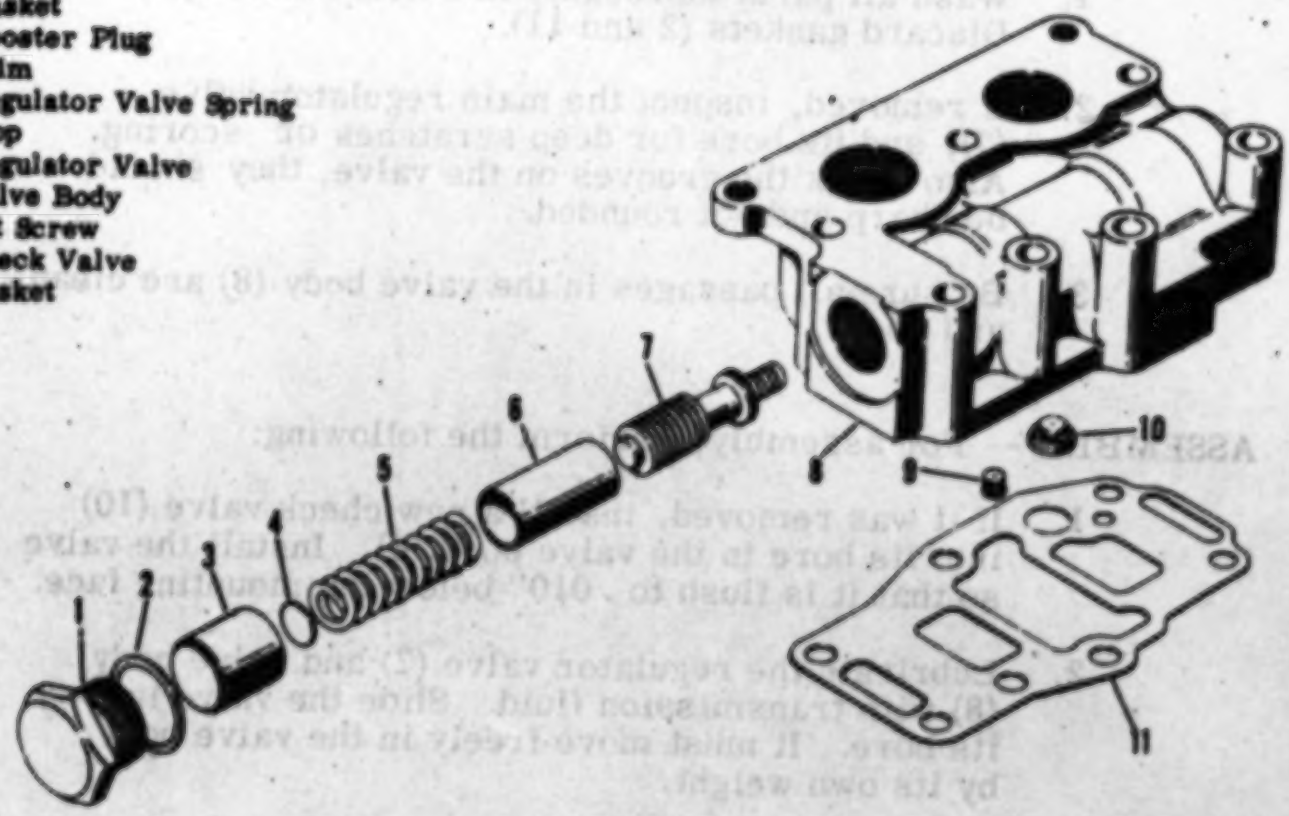


Fig. 9 Exploded view of main regulator valve

DISASSEMBLY -- For disassembly, perform the following steps:

1. Remove the plug (1) with gasket (2) and shake out booster plug (3) and regulator valve spring (5). Be careful not to lose the shims (4) which are installed in the ID of the booster plug.

2. Remove the Allen head set screw (9) from the valve body (8), then slide out the valve stop (6).

3. Slide the main regulator valve (7) out of the valve body (8) only if it is necessary to do so.

4. If necessary, for replacement only, remove check valve (10) from valve body (8).

INSPECTION -- After disassembly, perform the following:

1. Wash all parts thoroughly in solvent and dry. Discard gaskets (2 and 11).

2. If removed, inspect the main regulator valve (7), and its bore for deep scratches or scoring. Also check the grooves on the valve, they should be sharp and not rounded.

3. Be sure all passages in the valve body (8) are clean and open.

ASSEMBLY -- For assembly, perform the following:

1. If it was removed, install a new check valve (10) into its bore in the valve body (8). Install the valve so that it is flush to .010" below the mounting face.

2. Lubricate the regulator valve (7) and valve body (8) with transmission fluid. Slide the valve into its bore. It must move freely in the valve body by its own weight.

3. Insert the valve stop (6) in the valve body (8). Be sure set screw holes are aligned when installing stop. Install the set screw (9) and torque to 1-18 ft. lbs.

4. Place the original amount of shims (4) and spring (5) in booster plug (3) bore. Install assembly in valve body (8).

5. Place a new gasket (2) on plug (1) and thread into valve body (8).

6. Place new gasket (11) and valve assembly on converter housing and fasten with bolts and lockwashers. Torque bolts to 42-50 ft. lbs. Reconnect oil lines.

7. Check main oil pressure as mentioned earlier.

SECTION F -- EXAMINING THE BRAKE VALVE

DESCRIPTION -- For numbers in the following paragraphs, refer to Figure 10. The brake valve, which is attached to the left side of the brake housing, consists of the valve (3) and torque limiter valve assembly.

The torque limiter valve assembly consists of plug and pin (5), annular gasket (6), torque limiter spring (7) and torque limiter valve (8).

The snap ring (2) installed in the ID of the valve bore limits valve (3) travel.

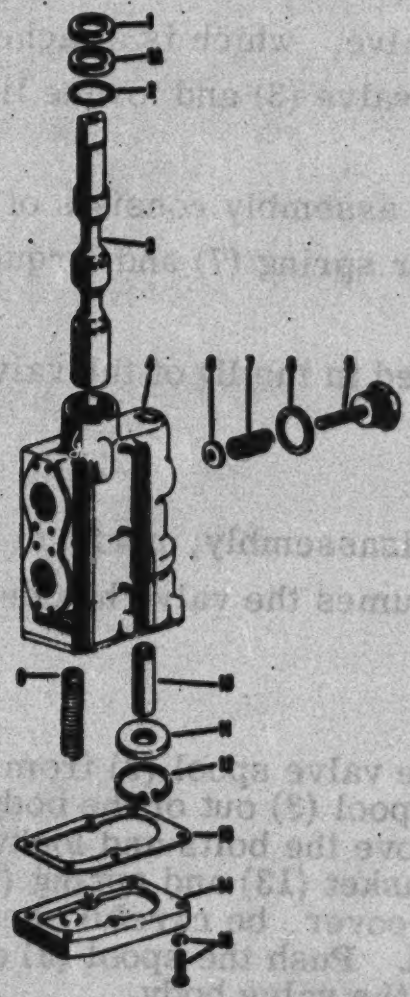
DISASSEMBLY -- For disassembly, perform the following: (NOTE: The following discussion assumes the valve has been properly removed from the brake housing).

1. To remove the valve spool (3) from the valve body (4), pull the spool (3) out of the body against snap ring (2), remove the bolts and lockwashers (15), cover (14), gasket (13) and spring (9). When removing the cover, be careful, because it is spring-loaded. Push the spool (3) out through the bottom of the valve body.

2. From the ID of the valve bore, pry out the wiper (1), oil seal (1A) and snap ring (2). Discard oil seal.

3. Remove the torque limiter valve plug assembly, (5) annular gasket (6), torque limiter spring (7) and torque limiter valve (8).

4. It is not necessary to remove the oil transfer tube (10) and retainer (11) unless replacement is necessary.



1-Wiper Ring
1A-Oil Seal
2-Snap Ring
3-Valve Spool
4-Valve Body
5-Plug Assembly
6-Gasket
7-Torque Limiter Spring
8-Torque Limiter Valve
9-Plunger Return Spring
10-Sleeve
11-Sleeve Retainer
12-Snap Ring
13-Gasket
14-Cover
15-Bolt & Lockwasher

Fig. 10 Exploded view of brake valve

INSPECTION -- After disassembly perform the following:

1. **Discard annular gasket (6), cover gasket (13) and snap rings (2 and 12) if they are bent out of shape.**

2. **Check the valve spool (3) and valve bore in body (4) for scoring or deep scratches. Replace if either is excessively damaged.**

3. **Check the seating of the torque limiter valve (8) on its seat in the valve body (4).**

ASSEMBLY -- For assembly, perform the following steps:

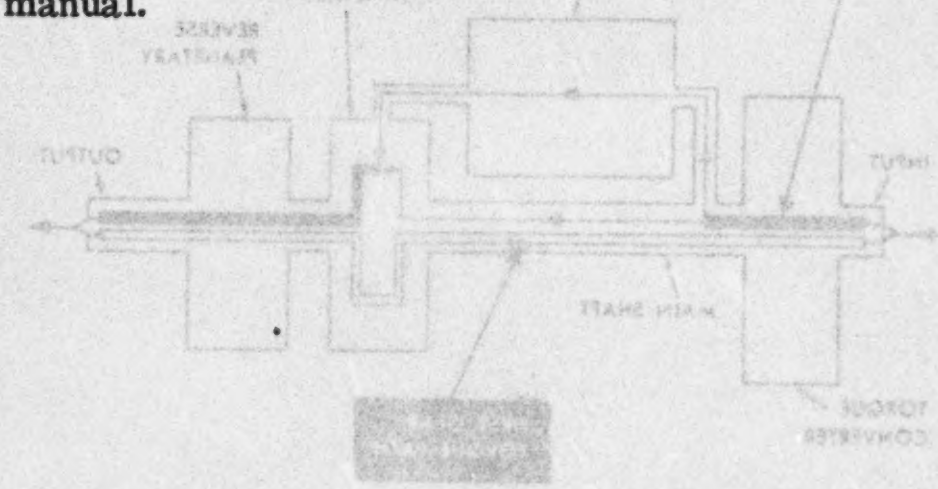
1. **Place a new annular gasket (6) on torque limiter valve plug assembly (5). Slide spring (7) and valve (8) on plug pin, then install the assembly in valve body (4) and tighten.**

2. **If removed, install oil transfer sleeve (10), retainer (11) and snap ring (12) in valve body (4).**

3. **Install the snap ring (2), oil seal (1A) and wiper (1). Press seal into body with lips toward snap ring.**

4. **Install oil valve spool (3) in valve bore, from the bottom of valve body (4). Push the plunger against the snap ring. Place spring (9) in the valve and install a new gasket (13), cover (14) and bolts and lockwashers (15). Torque bolts to 26-30 ft. lbs.**

NOTE: Install the valve assembly on the brake housing according to instructions in the maintenance manual.



SECTION G -- DUAL PATH TRANSMISSION PRINCIPLE

BASIC DIFFERENCE -- The dual path 8000 Allison transmission differs in three ways from the 5000 and 6000 series transmissions: 1) the primary torque members are bigger and heavier, to accommodate higher engine horsepower input; 2) the 5000 and 6000 series use four planetary gear sets, whereas the 8000 uses five; 3) in low (first) gear all the torque is transmitted from the converter through the transmission by the main shaft to a high reduction combining gear set, (8000 series), producing a 4.24 to 1 ratio at the output. The 5000 and 6000 series produce a 4.00 to 1 ratio in low gear.

Second through sixth ranges (8000 series) -- In each succeeding gear (2-6) where a balance of speed and torque is needed, the torque from the converter is divided between the main shaft and the planetary gear section, see Figure 11. As the transmission is upshifted for increased vehicle speed, an increased percentage of power is directed through the planetary gear section and a lessening amount is carried by the main shaft. Before leaving the transmission, the "dual path" flow of power is combined by the first gear planetary set.

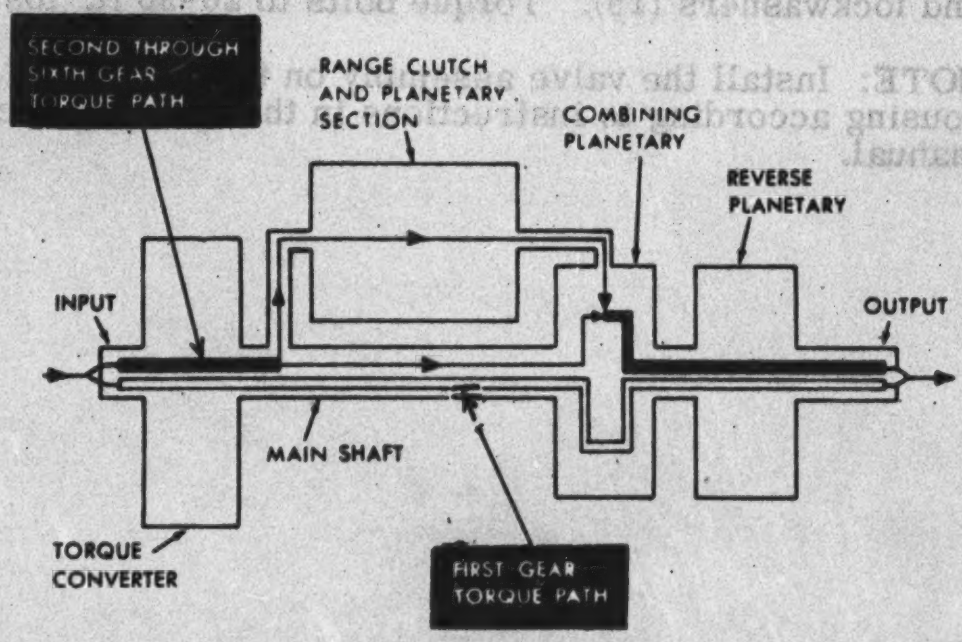


Fig. 11 Dual Path Principle

1

AM 2-10D
9/21/67

SUMMARIZING MECHANICAL AND AUTOMATIC TRANSMISSIONS

Human Engineering Institute

Minn. State Dept. of Ed.
Vocational Education

Press A 2

Check to see that timer is OFF.

2

This film lesson is basically a review of the previous nine films on mechanical and automatic transmissions. You should have little difficulty answering any of the questions. Howeve., if you have trouble, correction frames are given. Read every frame carefully and think before answering.

Press A 3

1-2

3

In a previous film, we learned that mechanical clutches are used with mechanical transmissions. In a transmission of this type, the operator must shift the gears manually. The mechanical clutch in this type of power train enables the operator to _____.

A. increase or decrease the engine torque output 4

B. gradually allow engine torque to be applied to the load 6

C. delay torque until engine builds up rpm 5

1-3

4

No. You are incorrect. Engine torque cannot be changed by the clutch. Torque is designed into the engine (small engines have low torque, large engines have high torque).

The operator can use the clutch to change into various gears. This is one reason for the clutch, but not the answer we want here. Try the question again.

Press A 3

1-4

5

No. Delaying torque until a certain rpm is reached is not the purpose of the clutch. It can be used in this manner but it is definitely not recommended. Try this question again.

Press A 3

1-5

6

OK. The clutch is a mechanism that allows the engine to take up the load gradually and without shock. The clutch also provides a means for disconnecting power (torque) from the load and for gear shifting purposes.

The cushioning device that most friction clutches have consists of _____.

A. a series of coil springs riveted to the pressure plate 7

B. a throw-out bearing mounted on the drive shaft 8

C. waved cushion springs mounted in the driven disk 9

1-6

7

No.
The cushioning device consists of waved cushion springs to which the friction faces are attached. These springs compress slightly as clutch engagement occurs.

Press A 9

1-7

8

No. The throw-out bearing moves up and down the shaft for another purpose.

The correct answer is: the cushioning device built into the friction plate consists of waved springs that compress slightly when clutch engagement occurs.

Press A 9

1-8

9

OK.
The waved springs on which the friction facings are attached compress a little when clutch engagement occurs.

The dampening effect comes from a series of coil springs (also mounted in the friction disk) placed between the drive washers and riveted to the cushion springs and hub flange.

Press A 9.1 1-9

9.1

Clutch slipping is frequently a complaint when mechanical transmissions and friction clutches are installed on a vehicle. Suppose we take one that was slipping badly. Probably the first thing to do would be to _____.

A. remove the clutch and check the return springs 10
B. check for misalignment of the engine and transmission 10
C. check pedal linkage and readjust if necessary 11

1-9A

10

No. To check either the return springs or misalignment of the engine and transmission would require a complete teardown of the unit. Remember, check for simple things first. In this case it may be pedal linkage.

Press A 11

1-10

11

OK.
If readjusting, lubricating and freeing the linkage does not remedy the situation, then the only thing left to do is pull the clutch and check the internal workings.

One condition inside the clutch that could cause slipping is a _____.

A. loose friction disk hub 12
B. worn out clutch throw-out bearing 12
C. Both A and B are wrong answers 13

1-11

12

No. You are incorrect. Neither a loose friction disk hub nor a worn out clutch throw-out bearing will cause a clutch to slip.

If these two components were bad, there would be a lot of clutch noise.

Press A 13 1-12

13

OK.
These two conditions would not cause clutch slipping. One thing that may cause excessive slipping is weak or broken pressure springs.

Another would be _____.

A. the operator riding the clutch 14
B. worn friction disks 15
C. Neither A or B is correct 14

1-13

14

No. The mechanic can only guess whether the clutch has been ridden excessively or not. Usually, if the clutch has been treated in this manner, it will be evident by badly worn friction disks, caused by overheating.

The answer we want here is: worn friction disks cause excessive slipping. Sometimes they are worn so badly that the rivets rub the driving plates.

Press A 16 1-14

15

OK.
Worn friction disks are common in the mechanical clutch. Some get so bad that the rivets that hold the friction material rub the driving plates, just as brake lining rivets rub the drums when they get worn.

Either a binding clutch linkage or a sticking release mechanism very often causes clutch problems. If the linkage binds and then releases suddenly, clutch chattering or grabbing will occur. This is caused by the driven disk being squeezed too quickly.

Press A 17 2-15

X(c)-16

16

The answer to the last question is: worn friction disks may cause excessive slipping. You have missed one or more of the questions in this sequence of material. Review the last few frames again -- read carefully and take your time answering the questions.

Press A 3 1-16

17

Let's talk about CLUTCH NOISES, which are common complaints with mechanical clutches. When trouble-shooting for clutch noise, the first step is to start the engine _____.

A. and rapidly release the pedal with the transmission in low gear 18
B. depress the clutch fully and shift into all gears, noting any mesh noise 19
C. and note whether the noise is heard when the clutch is engaged or disengaged 20

2-17

18

No. The proper procedure for testing clutch noise is to determine first whether the noise is heard when the clutch is engaged or disengaged with the engine idling. To rapidly release the pedal when the transmission is in low gear would only stall the engine.

Press A 20

2-18

19

No. Shifting from one gear to another with the clutch engaged would be only a partial test. It indicates noise that is present when the clutch is engaged (not necessarily when it is disengaged).

The answer we want here is: to leave the engine in idle and determine whether the clutch noise is present when the pedal is out, or fully depressed.

Press A 20 2-19

20

OK.
There are several conditions that could cause a noisy clutch, when the clutch is engaged. One of these is a friction disk hub that is loose on the clutch shaft. Another condition is broken or weak dampener springs on the friction disk. To repair this would require _____.

A. tightening up the friction disk hub 21
B. only replacing the springs in question 22
C. replacing the friction disk 23

2-20

21

No. Tightening up the friction disk hub will not help a condition of weak or broken dampener springs. The answer we want here is that the entire disk should be replaced. It is not feasible to replace the dampener springs because the friction face material is riveted to these springs.

Press A 23 2-21

22

No. It is not feasible to replace the weak or broken dampener springs because the friction face material is riveted to these springs. The standard policy is to remove and replace the entire friction disk or disks.

Press A 23

2-22

23

OK. It is standard policy to replace the entire friction disk in most shops because of the riveted parts involved.

There is one condition where shims can be used to correct malfunctions in the clutch. This is when _____.

A. the clutch pedal linkage is out of adjustment 24
B. there is misalignment of the engine and transmission 26
C. the friction disk hub is loose on the shaft 25

2-23

24

No. There are locknuts and other methods of pedal and linkage adjustments. The answer we want here is that shims can sometimes be used to correct a misalignment between the engine and transmission.

Press A 25

2-24

25

No. A loose disk hub would require the replacement of the friction disk or clutch shaft. The answer we wanted here is that shims can be used sometimes where there is a misalignment between the transmission and engine.

Press A 26

2-25

26

OK.
Sometimes misalignment can be corrected by shims. However, it may be other components that are causing this misalignment.

For example, the flywheel should be checked for wobble. Wobble can be caused either by a bent crankshaft or a flywheel which is not seated correctly on the crankshaft flange. Shims would not help in this case. If there is a bent crankshaft, it must be replaced. The same holds true if the flange is bent.

2-26

Press A 27

27

The purpose of a MECHANICAL TRANSMISSION is to _____.

A. provide a means of regulating the ratio between engine speed and rear wheel speed 29
B. provide a means of reducing engine speed over rear wheel speed 28
C. Neither A or B is correct 28

2-27

28

No. The correct answer is to provide a means of regulating the ratio between engine speed and rear wheel speed. In other words, to get a reduction in wheel speed to increase the torque.

Press A 29

2-28

29

OK.
A transmission allows for something other than a 1:1 ratio between the crankshaft and driveshaft. In addition, the mechanical transmission permits the vehicle to run in reverse through the utilization of _____.

A. an extra gear 30
B. an idler gear 31
C. a separate set of gears 30

2-29

30

Not quite. The mechanical transmission contains an extra gear, called an idler gear, which permits reverse rotation of the driveshaft.

Press A 31

2-30

31

OK.
The idler gear, when meshed properly within the transmission permits reverse rotation of the driveshaft and consequently, reverse rotation of the rear wheels.

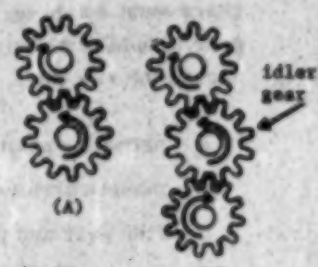
As we learned earlier, the idler gear _____.

A. provides more torque 32
B. provides less torque 32
C. does not change the ratio 33

2-31

32

No. The idler gear makes no change between the ratio of the gears with which it meshes. It simply changes the direction of the driven gear. Notice in (B) that the two outer gears are turning in the same direction.



Press A 33

2-32

33

OK.

An idler gear between two other gears only changes the direction of the driven gear. No torque or ratio change is involved.

We learned that the Allison transmissions use a _____ pump.

A. positive displacement, crescent type rotary 34
B. non-positive displacement, spur type rotary 34
C. positive displacement type 35

2-33

34

No. The Allison transmission uses a positive displacement spur type gear pump which provides a positive internal seal against slippage.

Press A 35

2-34

35

OK.

The positive displacement type pump also incorporates relief valves to provide a positive internal seal against slippage.

We learned that there are several ways that power can be transmitted through planetary gears. Power from the engine may be driving through the sun gear, planet carrier or the _____.

A. planetary pinion 36
B. ring gear 37
C. propeller shaft 36

2-35

36

You are incorrect.

The engine is not connected directly to the propeller shaft. If it were, the transmission would be completely bypassed. The engine may be connected to the ring gear, sun gear or the planet carrier.

Press A 37

2-36

37

OK.

The propeller shaft (driven member) may be connected to one of the three members and the engine to another.

Another condition that must exist before power can be transmitted is _____.

A. one member must be held stationary 39
B. two members must be held stationary 38
C. all three members must be free to rotate 38

2-37

38

You are incorrect.

If two members were held stationary, there would be no power transmitted, and if all the members were free to rotate there would be no power transmitted either. All members free to rotate is the NEUTRAL position.

Press A 39

2-38

39

OK.

Maximum reduction from a set of planetary gears is obtained as follows: The engine drives the sun gear; the propeller shaft is connected to the planet carrier; and the ring gear is _____.

A. left free to rotate 40
B. rotated in the opposite direction 40
C. held stationary 41

2-39

40

You are incorrect.

There are no provisions for rotating the ring gear member in the opposite direction; if it is left free to rotate, no power will be transmitted to the output shaft. The correct answer is "held stationary".

Press A 41

2-40

41

OK.
As the sun gear rotates with the engine, the planet gears must rotate on their shafts. Since the ring gear is held stationary, the planet gears will walk around the ring gear, thus rotating the _____

A. propeller shaft and axle 42
B. planet carrier and propeller shaft 43
C. ring gear and propeller shaft 42

2-41

42

You are incorrect.

When the ring gear is held stationary, the planet gears will walk around the ring gear, thus rotating the planet carrier and propeller shaft.

Press .. 43

2-42

43

OK.
MAXIMUM OVERDRIVE -- Planetary gears may be used to increase as well as to reduce speed. If the engine is connected to the planet carrier and the sun gear is connected to the propeller shaft, a maximum overdrive is accomplished when the ring gear is _____.

A. left free to turn 44
B. held stationary 45
C. locked to the planet car[illegible] 44

2-43

44

No. You are incorrect. The ring gear must be held stationary for any power to be transmitted through the planetary gear train.

Press A 45

2-44

45

OK.
MINIMUM OVERDRIVE -- A minimum overdrive is the type usually found in automotive equipment that has an overdrive incorporated into the transmission. The hookup of the driving members is opposite that for minimum speed reduction. Because the driving and driven members have changed places, the result will be _____

A. an increase in speed instead of a decrease 47
B. a decrease in speed instead of an increase 46
C. neither an increase nor a decrease 46

2-45

46

No. You have made a wrong choice. The answer we want here is that an increase in speed instead of a decrease will occur.

Press A 47

2-46

47

OK.
REVERSE REDUCTION -- So far we have considered only those setups where the driving and driven members are rotating in the same direction. In planetary gears, reverse direction can be accomplished in a speed reduction, overdrive and direct drive. When a reverse reduction is desired, the engine is made to drive the sun gear; and the planet carrier is _____

A. left free to rotate 48
B. locked to the planet gears 48
C. held stationary 49

2-47

48

No. You are incorrect. The planet carrier is held stationary or no power will be transmitted through the planetary gear train.

Press A 49

2-48

49

OK.
The sun gear is driven in the same direction as the engine (clockwise), causing the planet gears to rotate counterclockwise. Since the planet carrier is held stationary, the planet gears rotate on their shafts and cause the ring gear to rotate in the opposite direction from the sun gear.

Press A 51

X(c)-50

3-49

50

OK.
You have missed a few of these review questions. Before going on, review the last few frames again. Read carefully and take your time in answering the questions.

Press A 17

2-50

51

FLUID COUPLING REVIEW -- In a fluid coupling the pump portion is _____.

A. connected to the transmission shaft 52
B. connected to engine crankshaft 53
C. free floating within two outer members 52

3-51

52

No. The fluid coupling, sometimes referred to as the fluid flywheel, has only two members. One is the pump (driving member connected to the engine crankshaft), and the other is the turbine (driven member connected to the transmission input shaft).

Press A 53

3-52

53

OK.
A continuous flow of oil against the turbine blades is required to transfer sufficient energy to keep a vehicle in motion.

A continuous circulation of the fluid in the fluid flywheel is accomplished by _____.

A. continuously replenishing the pump half with new oil 54
B. the action of the turbine 55
C. Neither A or B is correct 54

3-53

54

No. The correct answer is "the action of the turbine". Since the turbine is forced to turn through the action of the oil, and since it is dished out like the pump half (only facing the pump), oil is thrown back out through centrifugal force. Hence, the oil is re-used.

Press A 55

3-54

55

OK. A continuous flow of oil is produced by the action of the turbine. No continuous replenishing of the oil is required; it is a closed system. Oil pressure is maintained within the coupling by an outside pump.

In a fluid flywheel coupling, the loss incurred through torque transfer is greater at _____.

A. high speed 56
B. low speed 57
C. There is no loss at any speed 56

3-55

56

No. There is a greater loss at low engine speeds. In fact, at idle there is practically a 100 percent loss. An indication that some torque is being transferred at idle is that the vehicle will creep slightly at idle while in gear.

Press A 57

3-56

57

OK. The loss is greater at low speeds. At full throttle, the loss incurred in the fluid flywheel is not more than two percent.

The stators in a torque converter are designed to turn in _____.

A. one direction 59
B. both directions 58
C. neither direction 58

3-57

58

No. The stators can turn only in one direction. If they were able to rotate both ways, the fluid leaving the turbine would work against the pump, rather than assist it.

Press A 59

3-58

59

OK.
Converters have what are called free wheeling stators. They rotate very easily in one direction, and "lock up" instantly when pressure is applied to turn them in the other direction. The roller type clutch prevents movement in one direction. Press A 59.1

3-59

59.1

When this happens, torque multiplication is (1) _____ turbine speed is (2) _____ and vortex flow is becoming less.

A. (1) increasing (2) decreasing 60
B. (1) decreasing (2) increasing 61
C. Neither A or B is correct 60

3-59A

60

No. When the first stator starts revolving, there is not as much torque required as before, and the turbine speed is increasing.

Press A 61

3-60

61

OK. The converter acts as a fluid coupling as long as there is no load variation. Even a slight load will slow the turbine down. When this happens, first one stator, then the other will slow down, to meet the required torque multiplication.

If a load is placed on the turbine, the stator next to the _____ would slow down first.

A. pump 62
B. turbine 63

3-61

62

No. The stator next to the turbine would slow down first because the increased vortex flow of fluid will be attempting to force the stator in a reverse direction.

Press A 63

3-62

63

OK. As the turbine slows down, the vortex flow of fluid increases. This, in turn, attempts to stop the first stator from moving.

Turbine maintenance -- if the oil check (transmission) indicates a burnt odor, the problem is that the converter has been running with _____.

A. a low oil supply 64
B. water in the oil 65
C. Neither A or B is correct 66

3-63

64

No. A low oil supply makes the converter inoperative. Think about what has been said and try this question again.

Press A 63

3-64

65

No. If water has gotten into the transmission, there will be a milky appearance to the oil. Think about what has been said and try this question again.

Press A 63

3-65

66

Correct. Neither a low oil supply nor water in the oil will give the oil a burnt odor. This situation usually is caused by worn out clutches or by constantly overfilling the unit with oil.

Press A 67

3-66

67

OIL CHANGING -- Oil converter filters should be changed every 500 hours of operation. This is under normal operating conditions. The oil in a system must be changed whenever oil shows traces of dirt, or when discoloration or a burnt odor is evident. If metal particles (brass or aluminum) are found in the screen, the entire system must be torn down, cleaned and rebuilt. Brass filings found in the screen would be an indication of _____.

A. turbine to stator interference 68
B. pump to stator interference 68
C. Neither A or B is correct 69

3-67

68

No. The brass filings would indicate a malfunction in the transmission, namely, the piston clutches. All parts in the turbine are aluminum.

Press A 69

3-68

69

OK. Aluminum particles in the screen would be from a turbine to stator or stator to pump interference. Brass filings would indicate the piston clutches are wearing badly.

Another important thing that must be done when the oil in a transmission is changed is to _____.

A. change the oil cooler 70
B. change the filters 71
C. do nothing, changing the oil is sufficient 70

3-69

70

No. If you said change the oil cooler, or just changing the oil is sufficient, you are incorrect. B is an established policy at most installations, that every time the oil is changed the filters must also be changed (under normal operating conditions).

Press A 71

3-70

71

OK. Change the filters every time the oil is changed, approximately every 500 hours of operation.

When a low converter out pressure is indicated, the cause could be one of the following:

1. low oil level
2. oil line leakage
3. plugged oil strainer
4. defective oil pump
5. high oil temperature
6. foaming oil
7. converter pressure regulator stuck open

Press A 71.1

3-71

71.1

A high oil temperature could be caused by _____ _____.

A. low engine output 72
B. overfilling 73
C. Neither A or B is correct 72

3-71A

72

No. The correct answer is that overfilling may cause oil turbulence and overheating.

Press A 73

3-72

73

OK. Also, if a stator is installed backwards, the violent churning and swirling of oil will cause overheating.

Foaming oil also causes overheating. Overheating under these circumstances could be compared to _____.

A. a loose fan belt 74
B. air in the engine coolant 75
C. a radiator without a pressure cap 74

3-73

74

No. If you said a loose fan belt, or a radiator without a pressure cap, you are incorrect. Although both of these conditions can cause overheating, air in the engine coolant is a closer comparison to oil foaming. Foaming oil prevents the proper heat dissipation needed in the converter because each bubble in the oil creates a type of vacuum.

Press A 75

3-74

75

OK. Air in the engine coolant is comparable to foamed oil. Both contain air bubbles resulting from either excessive churning, too low a liquid level, or some condition which allows air to mix with the liquid.

HIGH ENGINE SPEED AT CONVERTER STALL -- All of the following conditions will cause high engine speed at converter stall except one -- choose the one that will not.

A. low oil level 76
B. low converter out pressure 76
C. high oil temperature 76
D. slipping clutch 76
E. stator installed without rollers 77

3-75

76

No. You have made the wrong choice. Stators installed without rollers will not cause high engine speed at converter stall.

Press A 77

3-76

77

OK. The stator being installed without rollers is the condition that would not cause high engine speed at converter stall. Having high engine speed at converter stall means that there is little or no restriction being offered to the engine crankshaft. If the stator is allowed to "freewheel" in both directions, the oil will work against itself coming out of the turbine, causing a low engine speed in place of a high engine speed.

Press A 79 X(C)-78

3-77

78

The correct answer to the last question was "stator installed without rollers".

You have missed one or more of the questions in this sequence of material. Review the information again and answer the questions carefully.

Press A 53

3-78

79

Loss of Power -- The following conditions can cause a loss of power:

1. stator installed backwards
2. stator installed without rollers
3. low converter charging pressure
4. low engine speed at converter stall
5. clutch plates slipping
6. range control valve inoperative
7. low clutch pressure
8. foaming oil

Press A 79.1

3-79

79.1

Of the three conditions listed below, which of the following would make the unit completely inoperative?

A. clutch plates slipping 80
B. low converter charging pressure 80
C. range control valve inoperative 81

3-79A

80

No. If the clutch plates were slipping, or if there were a low converter charging pressure, there would still be movement and control although reduced from normal operation. However, if the range control valve were inoperative, there would be no control over the unit whatsoever.

Press A 81

3-80

81

OK. Without movement of the range control valve, the unit would be useless. There would be no power transmitted in any range.

If clutch plates in the transmission were slipping, there would also be _____.

A. a foaming oil condition 82
B. brass particles in the screen 83
C. Neither A or B is correct 82

3-81

82

No. Remember we said that a foaming oil condition causes a low converter out pressure. The correct answer here is that brass particles would be found in the screen, indicating clutch failure.

Press A 83

3-82

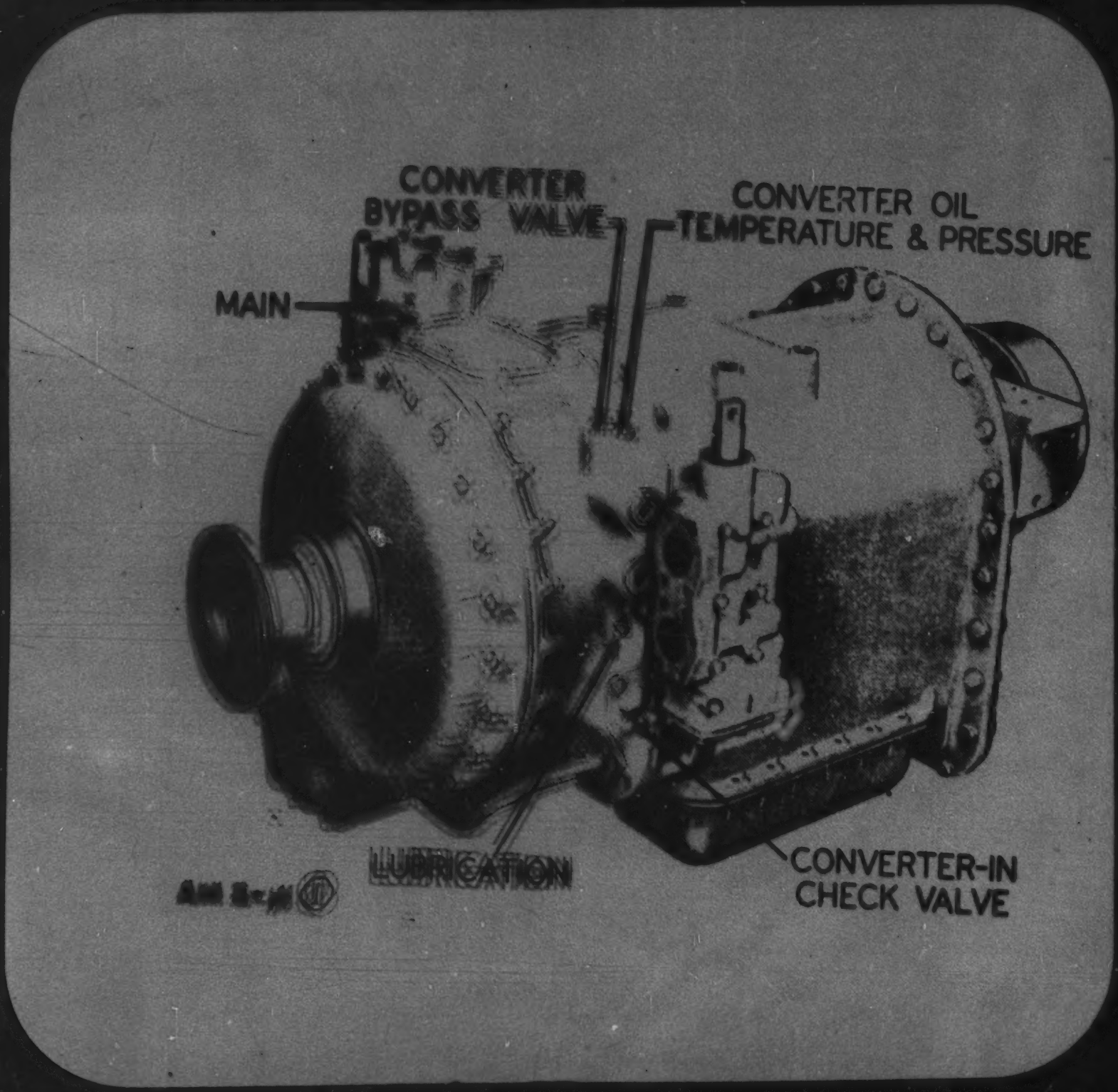
83

OK. Brass particles in the screen would indicate clutch failure, causing slipping in the various ranges.

Congratulations. You have completed this summary film on Mechanical and Automatic Transmissions.

Press REWIND.

3-83



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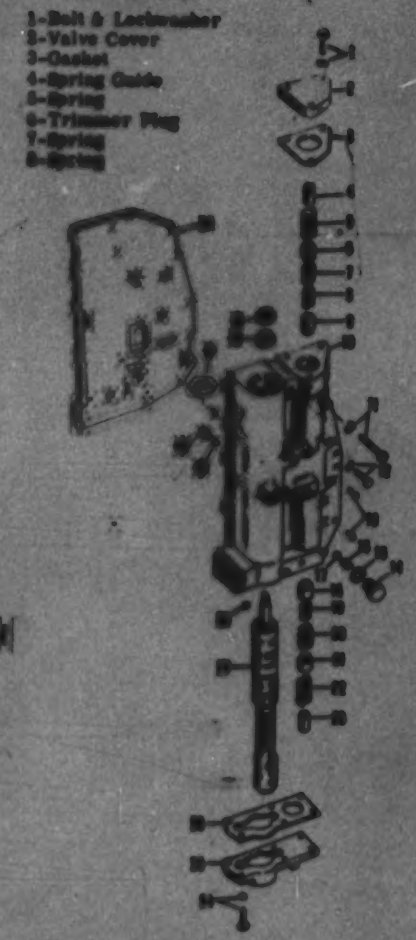

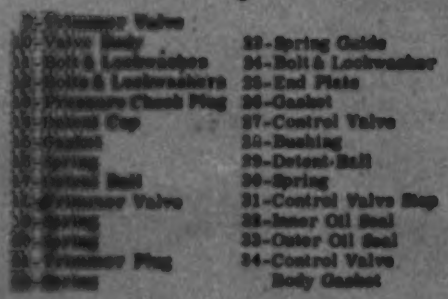

Exploded View of Range Control Valve

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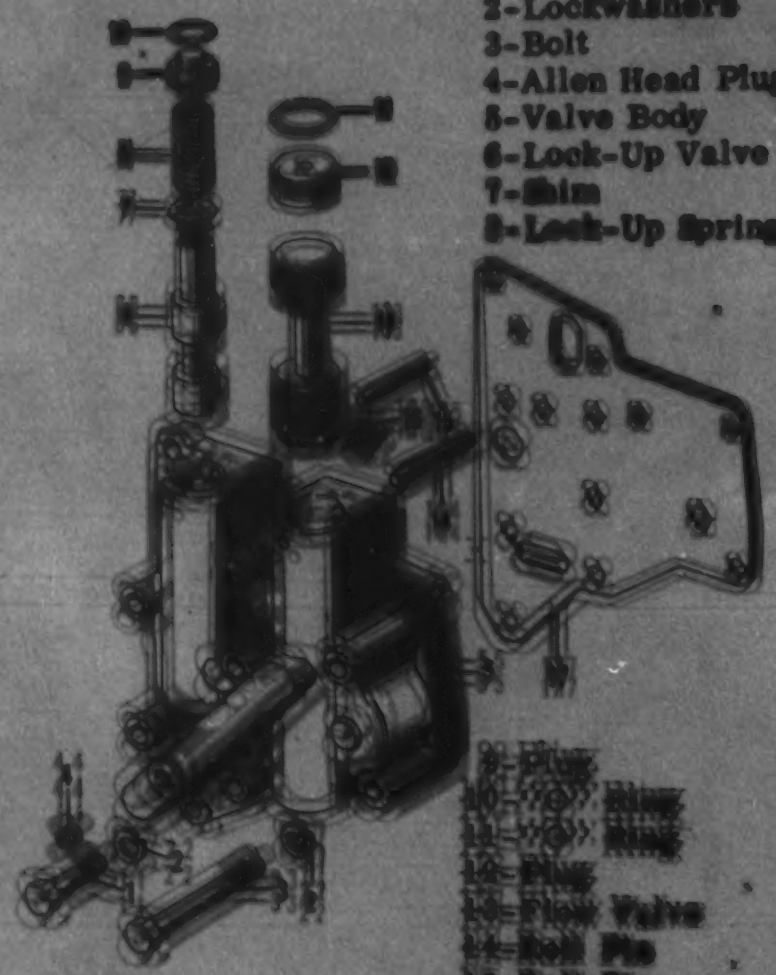

1-Bolt
2-Lockwashers
3-Bolt
4-Allen Head Plug
5-Valve Body
6-Lock-Up Valve
7-Shim
8-Lock-Up Spring
9-Plug
10-[illegible] Ring
11-[illegible] Ring
12-Plug
13-Flow Valve
14-Roll Pin
15-Roll Pin
16-Check Valve
17-Gasket

Exploded View of Lock-up and Flow Valve

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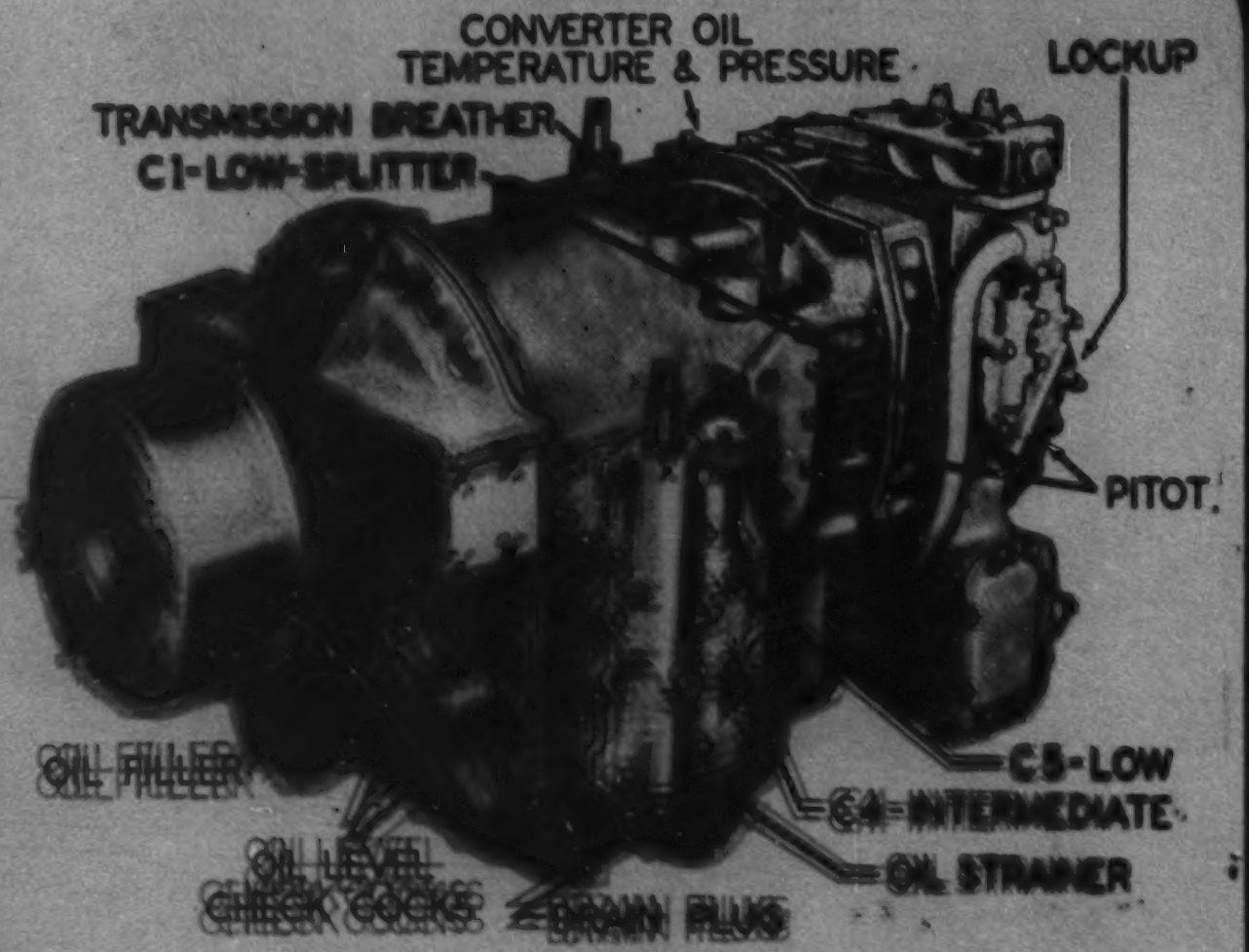

Oil Pressure Check Points

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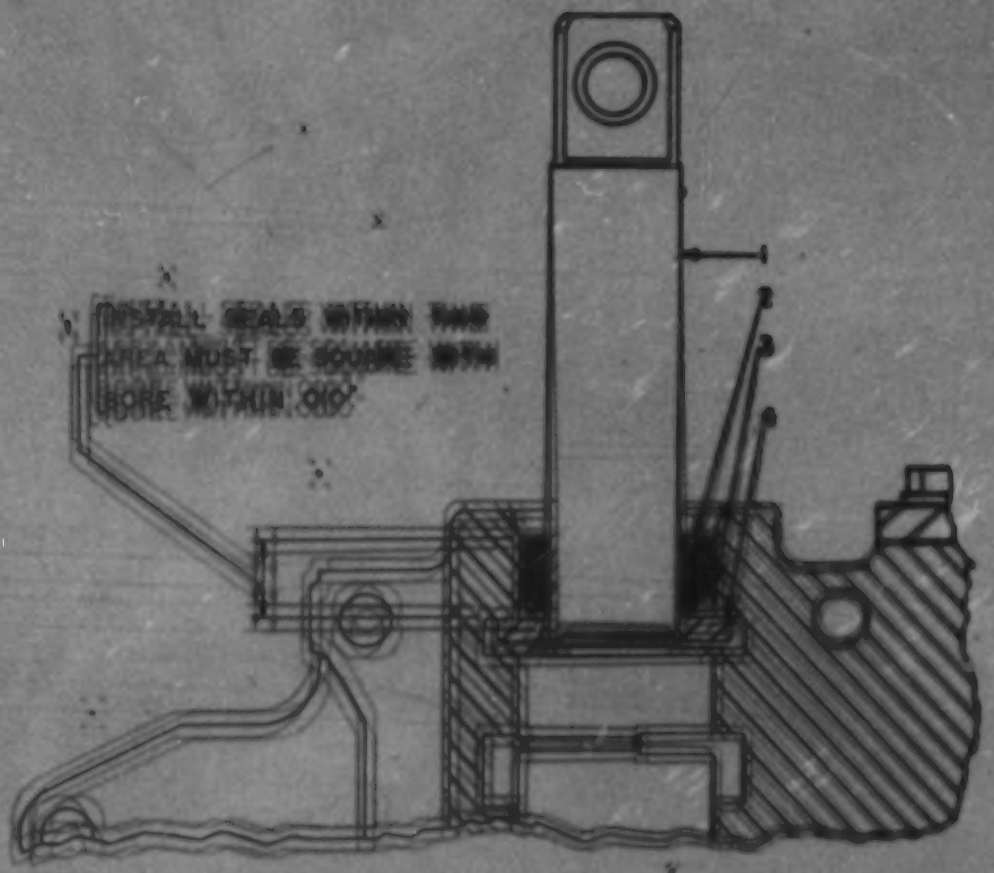

1-Control Valve
2-Outer Seal
3-Inner Seal
4-Valve Stop

AM2-10

Proper Seal Installation

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INSTRUCTOR'S GUIDE

Title of Unit: AUTOMATIC TRANSMISSIONS -- HYDRAULIC SYSTEMS (PART II) — AM 2-10 5/10/67

OBJECTIVES:

1. To complete the ten weeks of Allison Transmissions by covering, checking, servicing and inspection procedures.
2. To include some teardown and assembly procedures for components of the transmission that periodically require service.
3. To give an explanation of the Dual Path 8000 Series Allison Transmission

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LEARNING AIDS suggested:

VU-CELLS:

AM 2-10 (1) Oil and Temperature Check Points
AM 2-10 (2) Exploded View of Range Control Valve
AM 2-10 (3) Exploded View of Lock-Up and Flow Valve
AM 2-10 (4) Oil Pressure Check Points
AM 2-10 (5) Proper Seal Installation

NOTE TO INSTRUCTOR: There should be Allison Wall Charts, training aids, training films, slides etc. at your center. If not, contact your local Allison Distributor for these and other aids he may have available for use.

MODELS: Any component parts that can easily be brought to class would be helpful for demonstration and assembly or disassembly purposes.

QUESTIONS FOR DISCUSSION AND GROUP PARTICIPATION:

1. How is the stall test conducted?
2. What must be done to the vehicle before the stall test is conducted?
3. What steps are necessary to check the main oil pressure?
4. What do shims have to do with lock-up speed?
5. How is lock-up speed increased? How is it decreased?
6. What is the maximum converter oil temperature?

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7. What steps are required to check for locked stators?

8. What is indicated by the presence of metal particles in the transmission oil?

9. What is suggested when discolored oil shows up in the transmission?

10. What is meant by a 'COLD' oil level check? Explain

11. What are the proper steps necessary to change oil in the Allison Transmission?

12. What types of valves are used on the Allison Transmission? Explain.

13. What is the Dual Path principle?